no uses to which the electric motor does not lend itself in factories.

The objection which is often raised, however, to the replacing of steam-driven machinery by electricity, especially in chemical works, breweries, soap works, &c., is that the steam is required for heating and boiling; but here, again, it is a question of price only; the chief chemist of one of the most important soap makers in the east of London recently stated that it was purely a question of price for him to use electricity for boiling purposes instead of steam, and he estimated that it would pay him to do this if he could obtain it at not more than ½*d.* per unit.

Now a certain number of London factories are already supplied from the existing lighting stations. So great are the benefits of electricity that it has paid people to adopt it even although electric energy is so expensive, for so long as electricity is provided from electric lighting stations as an adjunct, so long must it necessarily be expensive; but the wholesale adoption of electricity in factories on the scale that it has taken place on Tyneside can only take place when electricity is produced on an enormous scale, and is used for all purposes in the district. Hitherto, power has been supplied as a bye-product of electric lighting, and this accounts for the fact that out of 555,000 horse-power required to drive the factories in the industrial districts of London, only some 26,000 or 27,000 horse-power of electric power is obtained from the present stations.

This great field that remains can only be tapped by putting down a system for the express purpose of supplying the power needs of East London; while such a scheme must, in order to produce cheaply, have as great a variety of consumers as possible, it cannot hope to be completely successful if it is made an adjunct of electric lighting or electric traction. Power supply must be the first aim of the undertaking, even although in the process of getting a power supply an even greater load may be obtained from the supply to railways.

The consumption of coal in domestic fires accounts for 4,570,000 tons a year, or 25 per cent. of the total consumption. Electric heating has hitherto been very little used, and even in America is confined to the heating of tramcars and workshops in places where it is only a question of the cost of electric energy is undoubted, and that electricity forms a most convenient agent in heating and cooking, and can replace all other forms, is now generally admitted. The reason is this, that whereas the ordinary gas fire only, as a rule, gives out from one-half to one-third of its heat usefully, while the best stove probably does not give out more than about 75 per cent. of its heat, the efficiency of the electric radiator is practically 100 per cent. It can be shown that if the cost of electricity be 1*s.* 3*d.*, it is as cheap for cooking as gas at 3*s.* per 1000 feet; but to compete with coal at 25*s.* a ton for heating, electricity must be supplied about ¼*d.* per unit. In a number of houses already electric radiators are being adopted on account of their convenience, even though they cost somewhat more than gas fires; with cheap electricity they would be adopted universally.

Thus, although electricity for heating and cooking has been looked upon as a purely Utopian proposal, as a matter of fact the time is not far distant when it will be found quite as cheap as any other form of heating. It is true that an electric radiator in its present form, although efficient in itself, converts but a very small portion of the energy of the *coal* into heat; but this is, of course, due to the inefficiency of the present methods of producing electricity, and there can be little doubt that we shall before very long witness a very considerable improvement in this respect. Whereas the best modern turbines and boilers convert only 15 per cent. of the energy of the coal into electricity, the internal combustion engine converts 35 per cent.; but even at the present time such are the advantages of electricity for heating and cooking, such is its applicability, such is the cost of re-decorating and cleansing in London, that at prices considerably higher than those above stated electricity would be as cheap to adopt as coal or gas. The question again resolves itself into one of price.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Goldsmiths' Company has resolved to make a grant of 10,000*l.* for the purpose of founding and endowing a readership in metallurgy, such readership to be associated with the name of the company. It is hoped that research and other work in the precious metals, and the theory and practice of assaying, will be kept somewhat prominently in view in connection with the proposed readership.

Mr. R. H. Biffen has been elected to the recently established chair of agricultural botany. Mr. Biffen is the author of numerous papers, the earlier of which dealt with the preparation of india-rubber and the coagulation of latex, and he has devoted a great deal of attention to fungi. His researches on the hybridisation of wheat and barley have attracted the attention of civilised Governments throughout the world, and attempts have been made to induce him to leave England and place his services at the disposal of at least one foreign Government. It is satisfactory that largely owing to the generosity of the Drapers' Company Mr. Biffen will be able to continue to carry on his researches in Cambridge.

Mr. C. L. Boulenger has been appointed assistant to the superintendent of the museum of zoology from March 25 to September 30, 1908.

ON Friday evening, March 13, Lord Alverstone distributed the certificates and prizes at the South-Western Polytechnic Institute, Chelsea. The report of the principal to the governing body showed that the session 1906–7 had been a very successful one, the highest honour obtained being the D.Sc. degree of Mr. Crocker, who had done all the necessary chemical research in the institute. In the course of a short address, Lord Alverstone laid great stress on the necessity for concentration in study. The development of any one subject is so great at the present time that the utmost concentration of thought is required to advance knowledge. He took as illustration the discoveries of Lord Kelvin in regard to the mariner's compass.

THE reports for the year ending June 30, 1907, of the librarian of the U.S. Congress and of the superintendent of the library building and grounds have been received from Washington. As indicative of the generous scale on which this great American library is subsidised, it may be stated that the appropriations made for the present year reach 123,000*l.*, and that the salaries to be paid during the year for the various officers reach 69,570*l.* In 1907 the number of books in the library reached 1,433,848, representing a gain of 54,604 over the previous year. In addition there were nearly 100,000 maps and charts and a quarter of a million prints. The most important accessions to the library were the Yudin library, consisting of 80,000 works relating to Siberia and Russia, and a notable collection of the literature of Japan, consisting of some 9000 works.

A BILL to promote agricultural education and nature-study in public elementary schools, introduced in the House of Commons by Mr. Jesse Collings, was read a second time on March 11. The object of the Bill is to provide for the teaching in all public elementary schools of agricultural and horticultural subjects; to give facilities for nature-study, and generally by means of object-lessons to cultivate habits of observation and inquiry on the part of the pupils. To this end the Bill provides for school gardens and such collection of objects as may be necessary for the practical illustration of the instruction given. The education specified in the Bill, while optional in urban schools, is to be compulsory in all schools situate in rural and semi-rural districts. A special grant, not exceeding 75 per cent. of the cost, is provided for in the Bill towards the expenses of local education authorities in carrying out the provisions of the Bill.

IN his capacity of Chancellor of the Bombay University, Sir George Clarke presided at the recent annual Convocation of the University and delivered an address. From a report of his speech in the *Pioneer Mail* we learn that

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the Chancellor directed attention to the fact that at present there is in the University no provision for post-graduate training, which, in Japan, can be carried on for five years. The University at present receives immature students, and has been unable to utilise the best of its teaching powers and to train up to the high standard now required to produce leaders of original research and professors in the great departments of knowledge. The institute which the munificence of the late Mr. Tata is providing will afford facilities for post-graduate courses in science, and Sir George Clarke expressed the hope that the University will be able to move in this direction in the future. India, he continued, is crying aloud for science, but in the last years only twenty-five degrees of Bachelor of Science were conferred as compared with 1321 Bachelorships of Arts. The Bombay system is defective in regard to scientific training. The inculcation of scientific ideas does not begin early enough, and cannot be carried far enough, for want of adequately equipped laboratories. In Japan science is taught in the upper primary courses, but does not appear until a much later stage in Bombay, and may almost be said to be confined to the colleges, which cannot all be equipped with the expensive appliances necessary for the training they ought to be able to impart. The attempt to make each college into a complete teaching university must, the Chancellor said, necessarily fail, and concentration, in the case of science training especially, appears to be essential. A beneficent patron of learning could render no better aid to the advancement of science than by providing the University with first-class physical and chemical laboratories. Principal Sharp has pointed out that expenditure on education in India would have to be increased from about four millions sterling to twenty-seven millions to provide an amount per head equal to that available in Japan.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 20.—"Notes on the Application of Low Temperatures to some Chemical Problems: (1) Use of Charcoal in Vapour Density Determinations; (2) Rotatory Power of Organic Substances." By Sir James **Dewar** and Dr. H. O. **Jones.**

(1) In a recent paper (*Phil. Mag.*, 1907, vi., 14, 408) Barkla and Sadler describe the investigation of the penetrating power of secondary Röntgen radiations emitted by different elements, which they find to be dependent on the atomic weight of the elements. The behaviour of nickel could only be reconciled with that of other elements by assigning to it an atomic weight of 61·4, a value considerably higher than the accepted value, 58·7.

Determinations of the vapour density of nickel carbonyl made by the authors (Proc. Roy. Soc., 1903, lxxi., 427) had given no indication that the accepted value for the atomic weight of nickel was too low, but it was considered of interest to make further determinations at low pressures, when the vapour would approximately obey the gas laws.

A new method of manipulation was devised for this purpose depending on the use of charcoal at low temperatures for absorbing gases.

A large flask, the volume of which with the connecting tubes was 2163·2 c.c., was connected to a mercury manometer and exhausted by means of a Fleuss pump followed by charcoal in liquid air. The flask was surrounded by melting ice, and the vapour admitted to any desired pressure. The mass of gas was finally collected in a weighed charcoal reservoir by immersing this in liquid air. Thus the weight of vapour filling the flask at 0° C. under a known pressure was easily determined. The accuracy of the method is dependent on the determination of pressure, since the errors in the other operations are comparatively negligible.

In order to test the method the vapour densities of carbon dioxide, sulphur dioxide, and ether were determined, and the following results (referred to 1 c.c. of hydrogen as 0·00009 gram) show that the method readily gives results sufficiently accurate for the purpose in hand:—

CO_2		SO_2		Ether	
Press mm.	V.D.	Press mm.	V.D.	Press mm.	V.D.
115·4	21·91	76·1	31·81	31·4	36·90
206·5	21·98	198·5	31·94	63·9	36·91

The theoretical values of these vapour densities are 21·83, 31·79, and 36·76 respectively.

Determinations of the vapour density of nickel carbonyl were then made, with the following results:—

Press mm.	V.D.	Press mm.	V.D.	Press mm.	V.D.
16 6	84·67	41 7	84·69	46·8	84·79

Taking the atomic weight of nickel as 58·3 (H=1), the theoretical density is 84·73, whereas on the assumption of the atomic weight suggested by Barkla and Sadler, 60·95 (H=1), the vapour density would be 86·05. These experiments therefore show that it is impossible that the atomic weight of nickel should be as high as 60·95.

The accuracy of the method used could be greatly improved by the use of a larger vessel and more delicate manometric measurement, and if the charcoal condenser was made of metal instead of glass the method might be applied to the more volatile gases.

(2) A preliminary account is given of the results obtained in determining the rotatory power of optically active carbon compounds at low temperatures. Two substances, *l*-nicotine and "bitter orange oil," were selected as suitable for examination, because their solutions in ethyl alcohol could be solidified without losing their transparency, and on account of their high rotatory powers. Up to the present it has only been found possible to make observations down to about −100° C., since below this double refraction interferes with the reading of the polarimeter.

A solution of nicotine (21·2 grams in 100 c.c.) which gave a rotation of −30° at +20° C. gave a rotation of −22° at −120° C.

The relation between temperature and rotatory power is approximately linear, and shows that nicotine behaves below 0° C. just as it does above that temperature. The specific rotatory power at −115° C. is calculated to be −99°, and, assuming the linear relation to hold, would be about −54° at −273° C.

The rotatory power of bitter orange oil increases with diminishing temperature below 0° C. as it does above that temperature.

A 20 per cent. solution in alcohol, which gave a rotation of +18°·5 at +8° C., gave a rotation of +25°·5 at −95° C. The relation between temperature and rotatory power is linear, and the calculated specific rotatory power at −273° C. would be about +156°.

Similar results have been obtained with other substances, and these show that the molecules of optically active carbon compounds would exhibit in all probability considerable rotatory power at the lowest temperatures we can command.

Linnean Society, February 20.—Lieut.-Col. Prain, F.R.S., vice-president, in the chair.—Wild types and species of the tuber-bearing Solanums: A. W. **Sutton.** Many hundreds of attempts were made to fertilise *Solanum Maglia* with the cultivated potato, but only one hybrid seedling resulted, from a cross made in July, 1887, and though cultivated for twenty years it has shown no superiority to ordinary potatoes. The so-called "*Solanum Commersonii*, Violet," was stated to be a mutation obtained through bud variation from the wild *Solanum Commersonii*, Dunal. In opposition to this claim, many growers assert that it is identical with a German potato, the "Blue Giant," raised by Herr Paulsen. Many wild types of tuber-bearing Solanums have been experimented with during the last few years. All these wild types flower freely, but in every case where a wild type produces fruit it has, with the exception of *Solanum etuberosum*, reproduced itself absolutely pure from seed, whereas all varieties of the cultivated potato which produce seed give rise to the greatest possible variation in the seedlings, none corresponding exactly to the parent. There is also a striking difference in the form of the pollen-grains of the wild types of tuber-bearing Solanums com-

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